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Meyer

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(54) **SYNCING APPARATUSES, PROCESS DOLLIES, AND CONVEYOR ASSEMBLIES**

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B25H 1/08 (2006.01)
B25H 1/00 (2006.01)

(52) **U.S. Cl.**

CPC ***B25H 1/10*** (2013.01); ***B25H 1/0007*** (2013.01); ***B25H 1/08*** (2013.01)

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USPC .... 269/56, 289 MR; 198/345.1, 345.2, 198/345.3; 104/168
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,134,940	A	8/1992	Fujita et al.	
5,513,428	A	5/1996	Shiramizu et al.	
6,164,430	A *	12/2000	Nishimura	B65G 47/8815 198/345.1
7,484,616	B2	2/2009	Nakamura	
8,011,491	B2	9/2011	Nakagawa et al.	
8,162,302	B2	4/2012	Turner et al.	
8,534,446	B2	9/2013	Stadler et al.	
8,627,942	B2	1/2014	Terazawa et al.	
8,708,131	B2 *	4/2014	Fukano	B65G 43/00 198/345.1

FOREIGN PATENT DOCUMENTS

WO 2008122381 A2 2/2009

* cited by examiner

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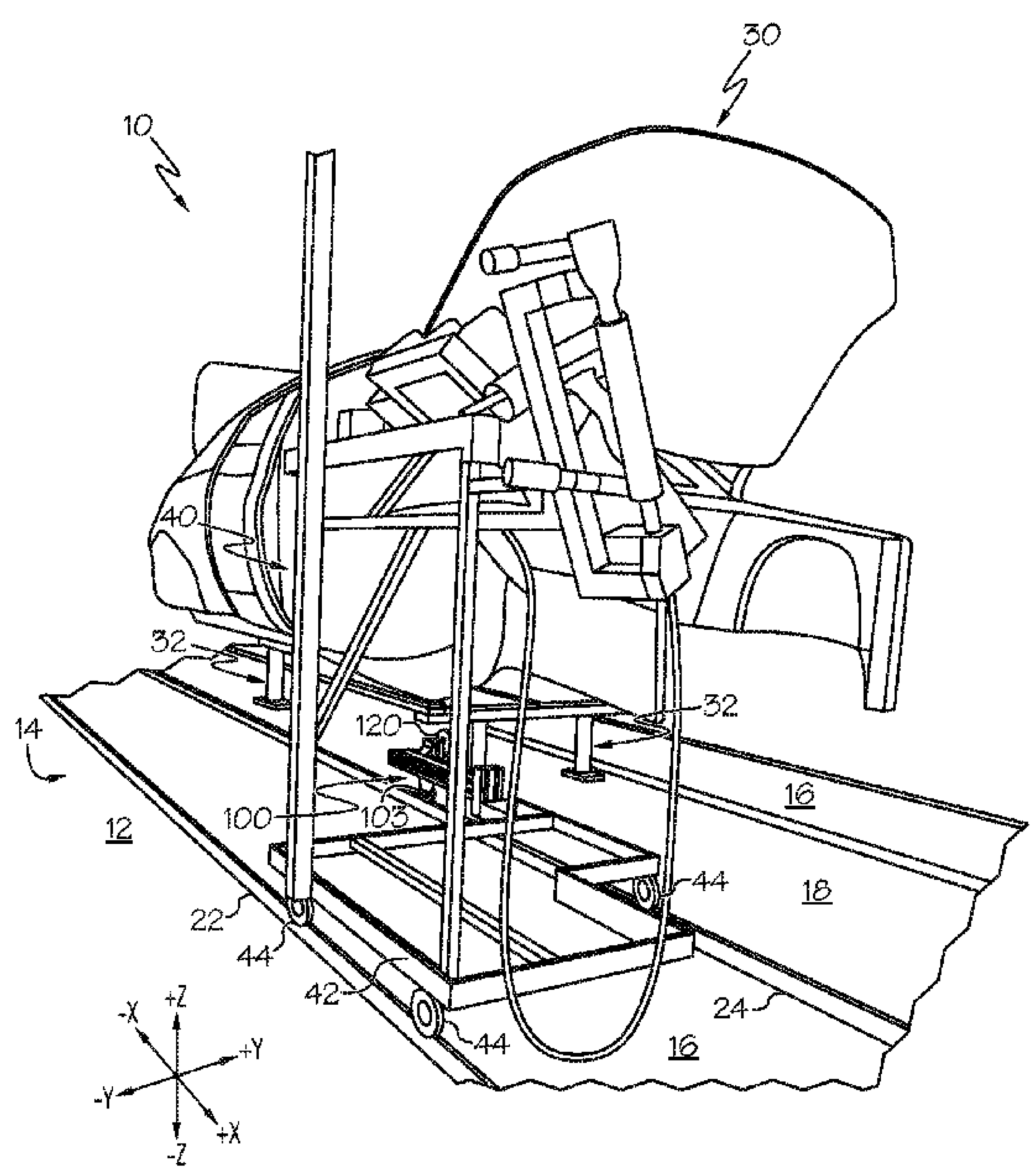
(57) **ABSTRACT**

A syncing apparatus for synchronizing a process dolly to a conveyor includes a mounting frame and a sync arm. The mounting frame is configured to be mounted to a frame of the process dolly. The sync arm is coupled to the mounting frame and includes a wheel and a biasing member coupled to the wheel and configured to bias the wheel to an extended position. The wheel is configured to contact a contact feature of the conveyor to synchronize the process dolly to a movement of the conveyor when biased to the extended position. Compression of the biasing member moves the wheel to a retracted position wherein the wheel is configured to traverse the contact feature of the conveyor and the process dolly is unsynchronized from the movement of the conveyor.

20 Claims, 7 Drawing Sheets



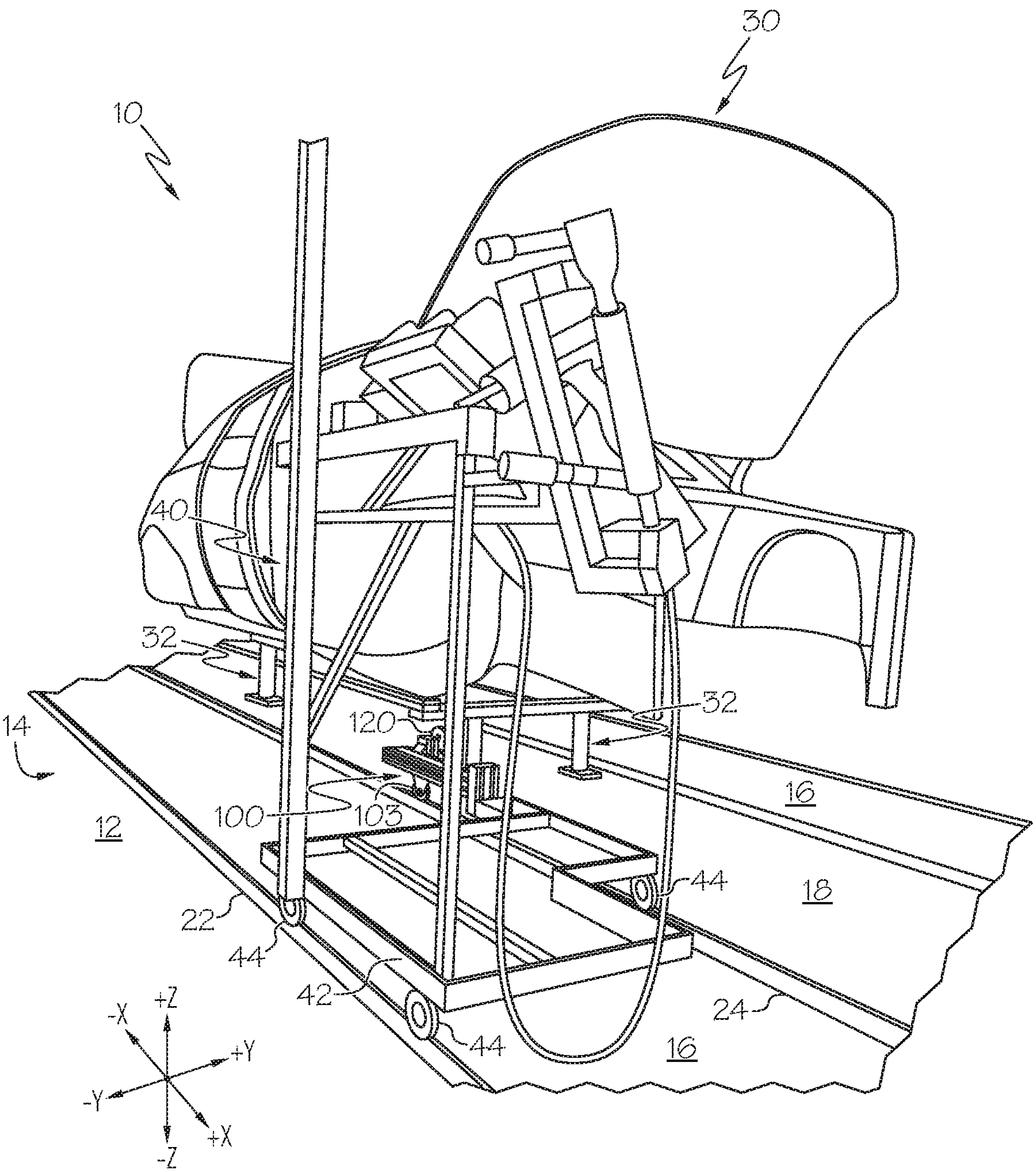
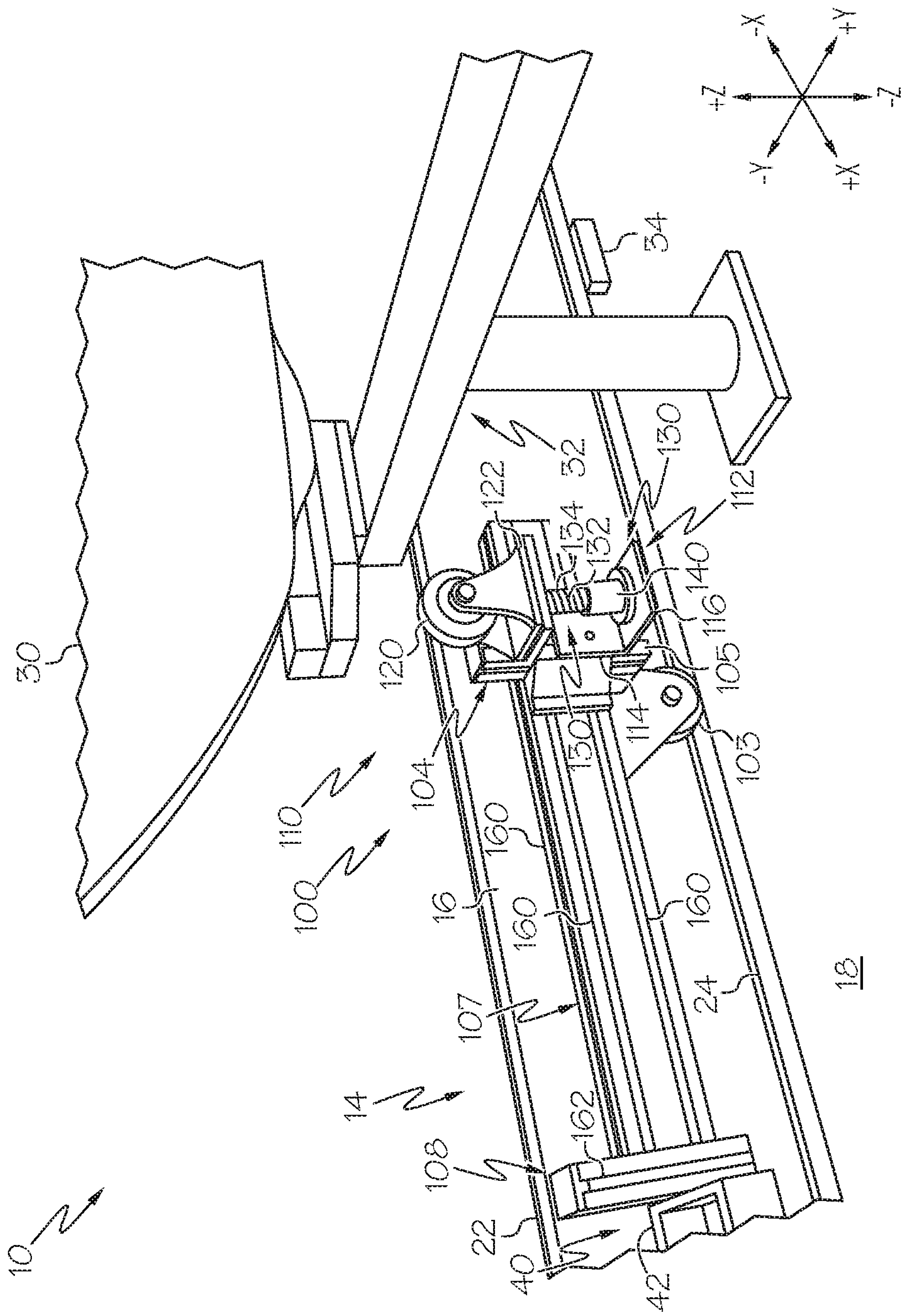


FIG. 1


10
14
16
18
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42
100
103
104
105
107
108
110
112
114
116
120
122
130
132
140
150
154
160
162
+X
-X
+Y
-Y
+Z
-Z

FIG. 2

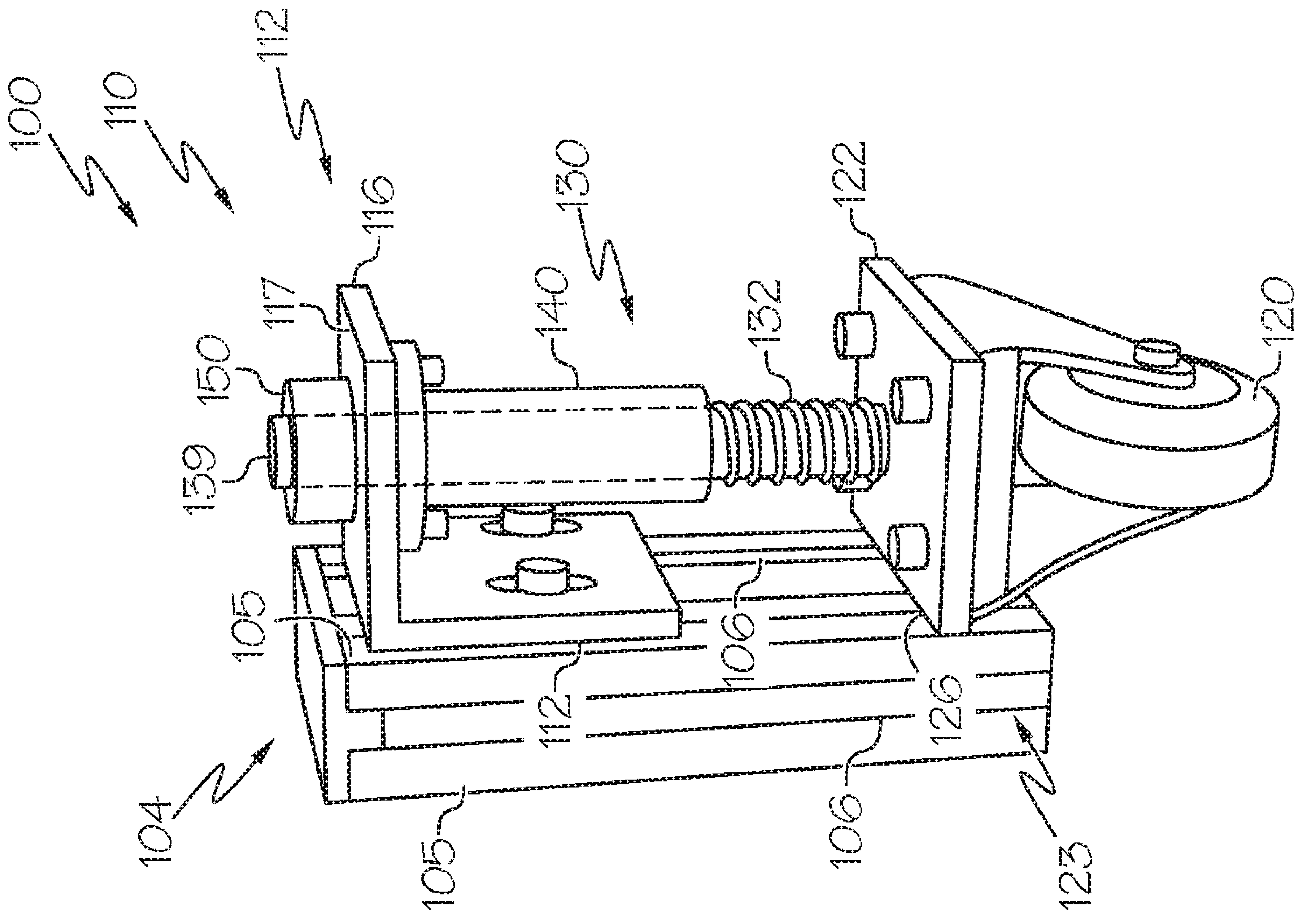
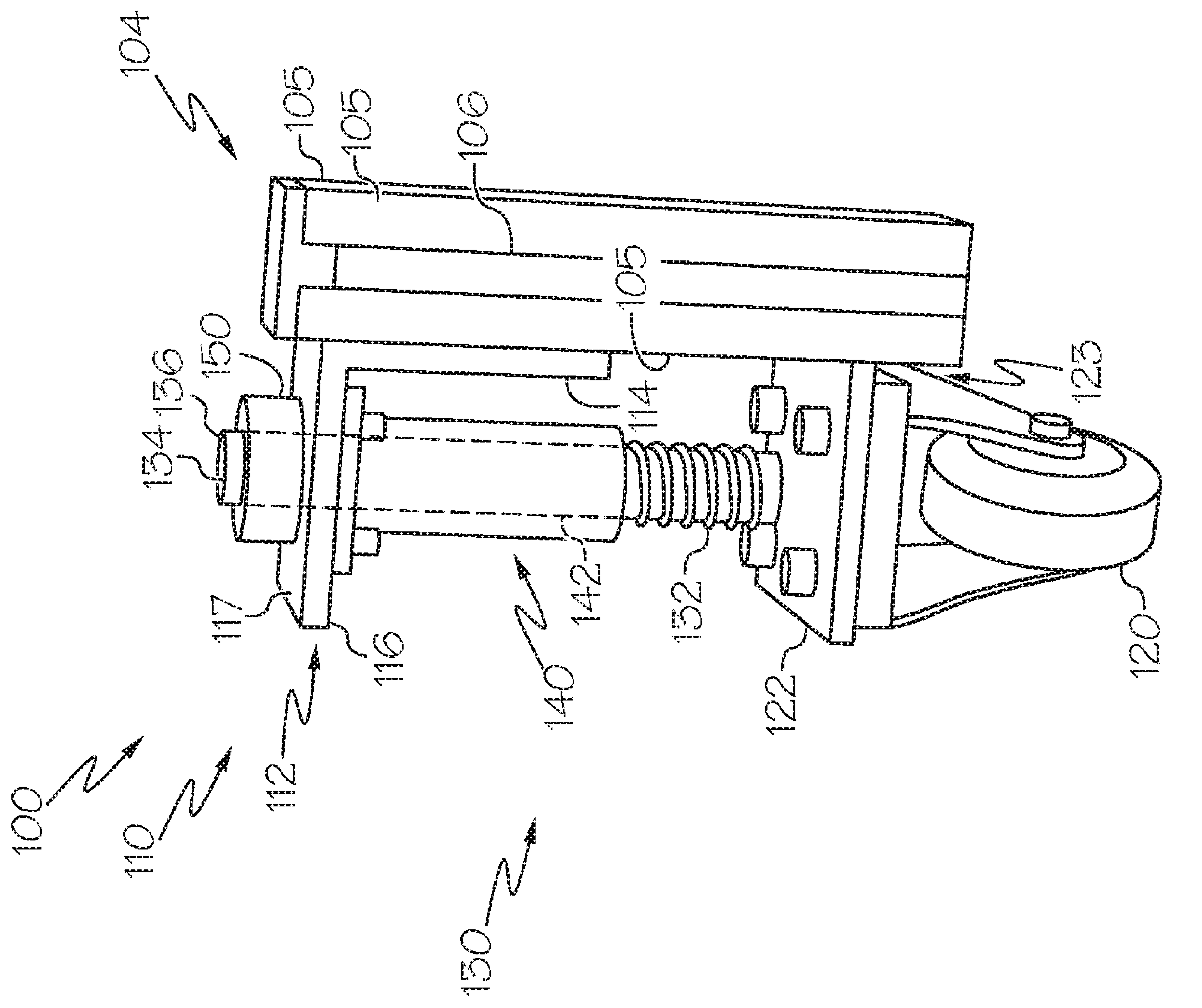

100
110
112
116
117
150
139
130
140
132
122
120
105
106
112
126
104
105
106
123

FIG. 3B


104
105
105
106
105
114
123
134
136
150
117
116
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110
100
140
142
132
122
120
130

FIG. 3A

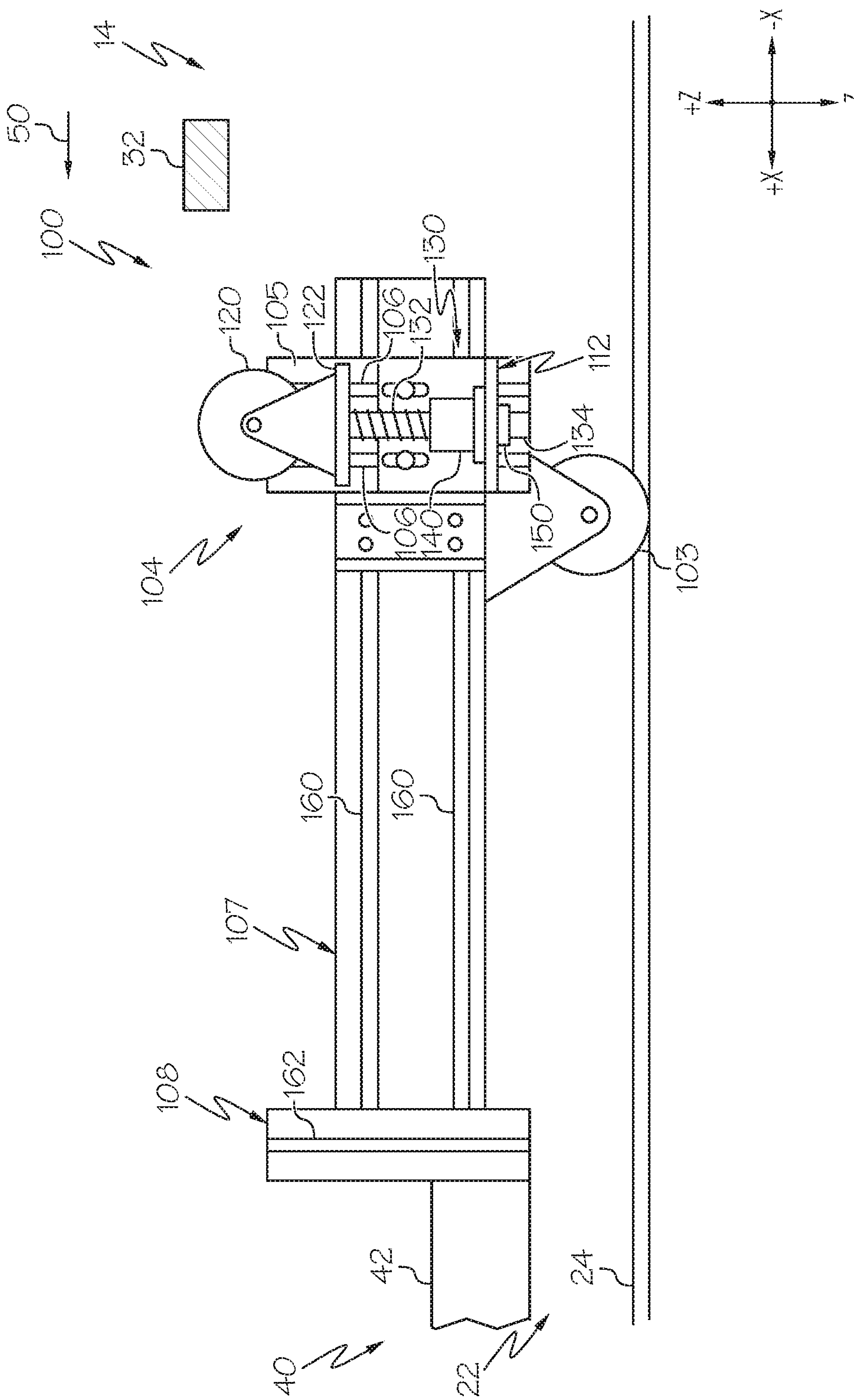
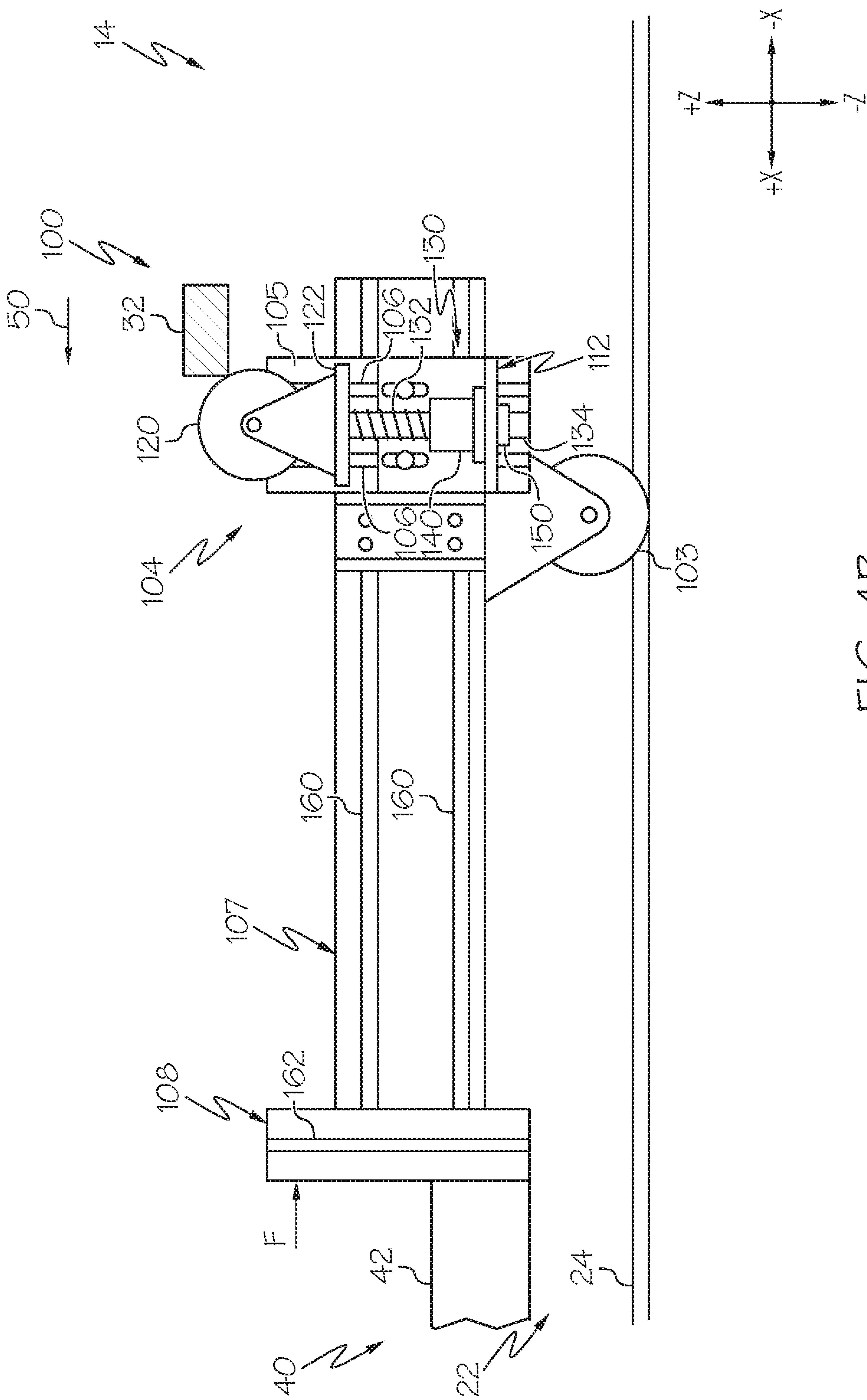

14
50
32
100
120
105
122
106
132
150
112
134
150
140
106
104
103
160
160
107
108
162
42
24
40
22
+Z
-Z
-X
+X

FIG. 4A


14
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32
105
122
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140
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103
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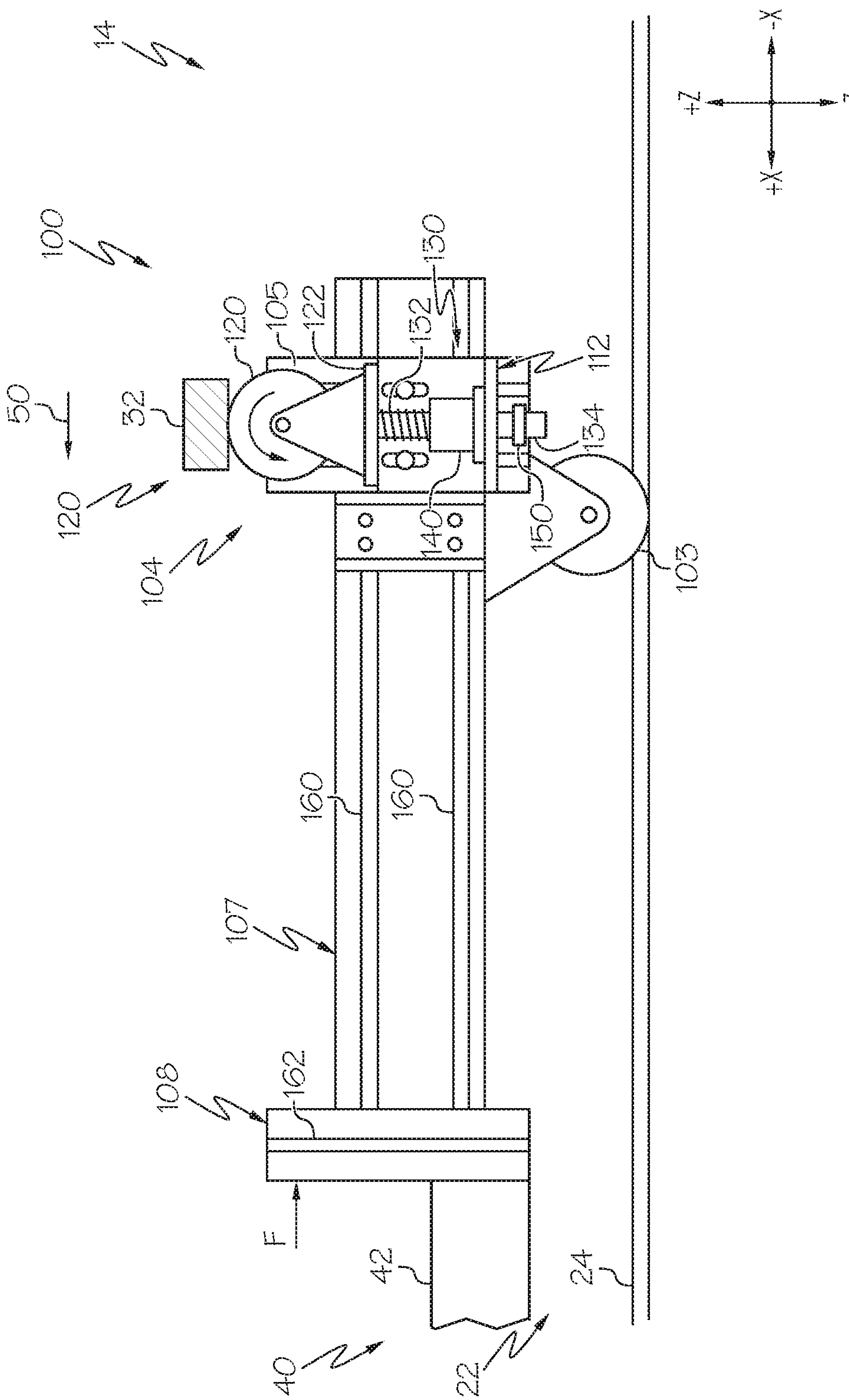
162
F
42
24
40
22
-X
+Z
-Z
+X

FIG. 4B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-X
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122
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107
108
162
F
42
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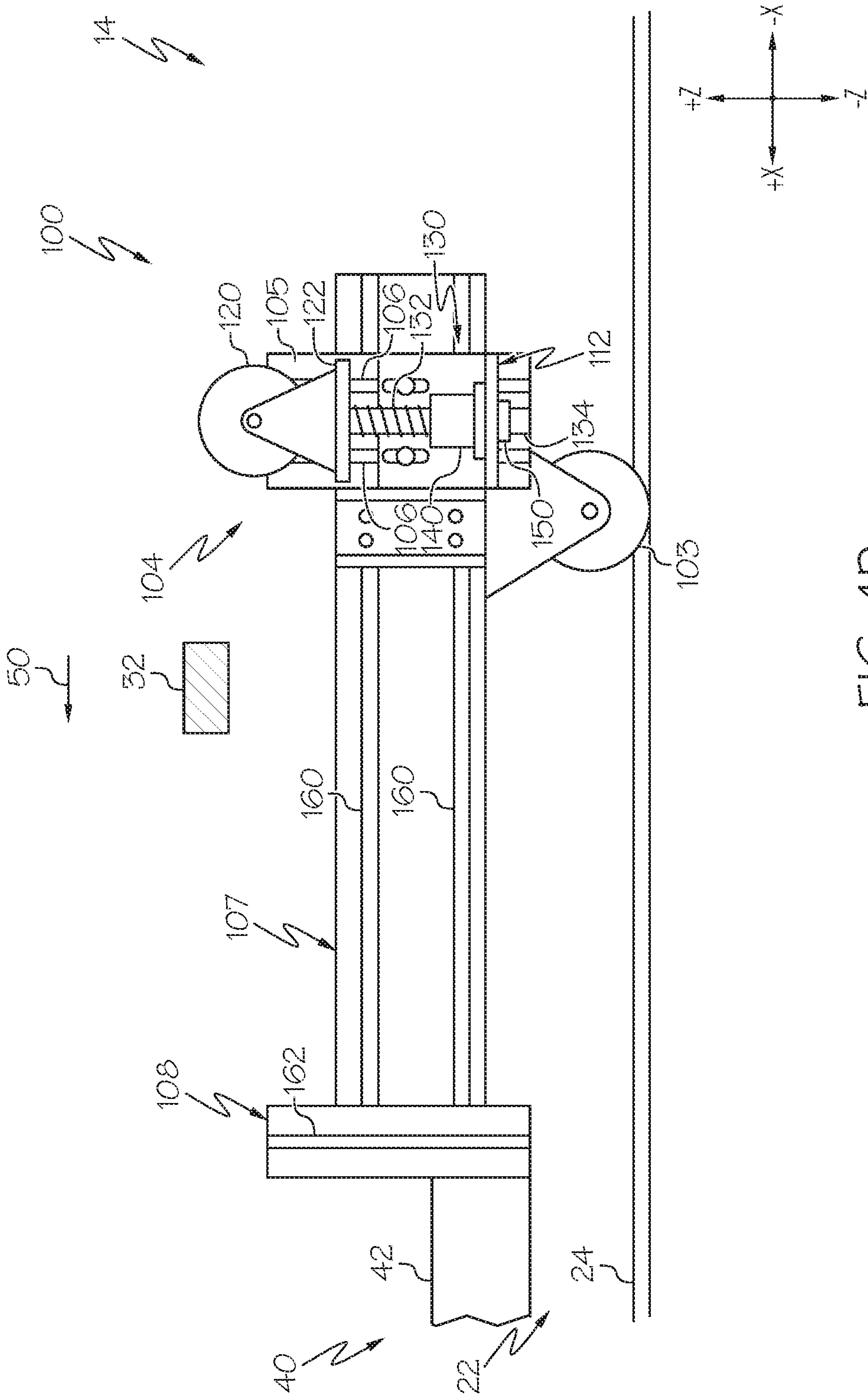
40
22

FIG. 4C


14
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122
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132
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22

FIG. 4D

SYNCING APPARATUSES, PROCESS DOLLIES, AND CONVEYOR ASSEMBLIES

TECHNICAL FIELD

The present specification generally relates to syncing apparatuses, process dollies, conveyor assemblies, and, more specifically, to syncing apparatuses, process dollies, and conveyor assemblies having synchronizing apparatuses for synchronizing process dollies to conveyors.

BACKGROUND

Process dollies are used in manufacturing processes to carry parts, tools, and the like for use along an assembly line. In particular, in the vehicle manufacturing industry, process dollies are configured to move at the same rate as a vehicle or vehicle component along an assembly line. For a process dolly to move at the same rate as a particular vehicle component, it must be synchronized to a portion of the conveyor assembly where the particular part is located. Conventionally, to sync a process dolly to a particular portion of the conveyor a block is coupled to the conveyor and the process dolly includes a urethane scraper that is positioned to contact the block. The contact between the urethane scraper and the block causes the process dolly to move along with the movement of the conveyor. However, such scrapers may wear out and become unreliable.

Accordingly, a need exists for alternative syncing apparatuses for synchronizing a process dolly to a motion of a conveyor.

SUMMARY

In one embodiment, a syncing apparatus for synchronizing a process dolly to a conveyor includes a mounting frame and a sync arm. The mounting frame is configured to be mounted to a frame of the process dolly. The sync arm is coupled to the mounting frame and includes a wheel and a biasing member coupled to the wheel and configured to bias the wheel to an extended position. The wheel is configured to contact a contact feature of the conveyor to synchronize the process dolly to a movement of the conveyor when biased to the extended position. Compression of the biasing member moves the wheel to a retracted position wherein the wheel is configured to traverse the contact feature of the conveyor and the process dolly is unsynchronized from the movement of the conveyor.

In another embodiment, a process dolly includes a frame and a syncing apparatus coupled to the frame and configured to synchronize the process dolly to a movement of a conveyor. The syncing apparatus includes a sync arm that includes a wheel and a biasing member coupled to the wheel. The biasing member biases the wheel to an extended position. The wheel is configured to contact a contact feature of the conveyor to synchronize the process dolly to the movement of the conveyor when biased to the extended position. Compression of the biasing member moves the wheel to a retracted position wherein the wheel is configured to traverse the contact feature of the conveyor and the process dolly is unsynchronized from the movement of the conveyor.

In yet another embodiment, a conveyor assembly includes a conveyor having a contact feature and a process dolly configured to be synchronized to a movement of the conveyor. The process dolly includes a frame and a syncing apparatus coupled to the frame and configured to synchronize the process dolly to the movement of the conveyor. The syncing apparatus includes a sync arm that includes a wheel and a biasing member coupled to the wheel. The biasing member biases the wheel to an extended position. The wheel is configured to contact the contact feature of the conveyor to synchronize the process dolly to the movement of the conveyor when biased to the extended position. Compression of the biasing member moves the wheel to a retracted position wherein the wheel is configured to traverse the contact feature of the conveyor and the process dolly is unsynchronized from the movement of the conveyor.

These and additional features provided by the embodiments described herein will be more fully understood in view of the following detailed description, in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The embodiments set forth in the drawings are illustrative and exemplary in nature and not intended to limit the subject matter defined by the claims. The following detailed description of the illustrative embodiments can be understood when read in conjunction with the following drawings, where like structure is indicated with like reference numerals and in which:

FIG. **1** depicts a perspective view of a conveyor assembly, according to one or more embodiments shown and described herein;

FIG. **2** depicts the conveyor assembly of FIG. **1** from an interior perspective, according to one or more embodiments shown and described herein;

FIG. **3**A depicts a front view of a syncing apparatus, according to one or more embodiments shown and described herein;

FIG. **3**B depicts a perspective view of the syncing apparatus of FIG. **3**A, according to one or more embodiments shown and described herein;

FIG. **4**A depicts a side view of a syncing apparatus prior to contact with a contact feature of a conveyor, according to one or more embodiments shown and described herein;

FIG. **4**B depicts a side view of the syncing apparatus of FIG. **4**A synchronized to a movement of the contact feature of the conveyor, according to one or more embodiments shown and described herein;

FIG. **4**C depicts a side view of the syncing apparatus of FIG. **4**B retracted to desynchronize from the contact feature of the conveyor assembly, according to one or more embodiments shown and described herein; and

FIG. **4**D depicts a side view of the syncing apparatus of FIG. **4**C after desynchronization from the contact feature of the conveyor assembly, according to one or more embodiments shown and described herein.

DETAILED DESCRIPTION

The figures generally depict a syncing apparatus for synchronizing a process dolly to a movement of a conveyor. In particular, syncing apparatuses according to the present disclosure generally include a wheel and a biasing member coupled to the wheel and configured to bias the wheel to an extended position. The conveyor may include a contact feature. The wheel may contact the contact feature such that the process dolly, to which the syncing apparatus is attached, moves with the contact feature of the conveyor. Then, the process dolly may move in synchronization with the conveyor due to contact between the syncing apparatus and the contact feature of the conveyor. When synchronization is no longer needed, force can be applied to the process dolly in a direction opposite the direction of movement of the conveyor. The contact feature may be positioned at such a height relative to the wheel that the force causes the wheel to roll over the contours of the contact feature while the biasing element allows the wheel of move to a retracted state such that the wheel remains in contact with the contact feature until it traverses completely past the contact feature. Accordingly, due to the rolling of the wheel over the contact feature, the syncing apparatus experiences much less wear than previous methods that used resilient urethane scrapers to contact conveyor contact features. Various embodiments of the syncing apparatus will be described in more detail herein.

Referring now to FIG. **1**, a conveyor assembly **10** is generally illustrated. The conveyor assembly **10** includes a conveyor **14**, a process dolly **40**, and a syncing apparatus **100** coupled to the process dolly **40**. The conveyor **14** of the illustrated embodiment is a floor conveyor. That is the floor conveyor is positioned in a floor or at floor level. While the illustrated embodiment shows a floor conveyor, embodiments of the present disclosure may be equally applicable to other types of conveyors including, elevated or overhead conveyors.

The conveyor **14** may include a work part conveyor portion **18** and a person conveyor portion **16**. The work part conveyor portion **18** and the person conveyor portion **16** may move parallel to one another at the same rate. Stated another way, the work part conveyor portion **18** and the person conveyor portion **16** move together in synchronization. The person conveyor portion **16** may allow a person to stand on the conveyor **14** at a desired location and move in synchronization with a work part **30** (e.g., a vehicle chassis) being carried along the work part conveyor portion **18**. In some embodiments there may be a person conveyor portion **16** on either side of the work part conveyor portion **18**, such as illustrated in FIG. **1**.

Between the work part conveyor portion **18** and the person conveyor portion **16** may be a stationary track **24**. A second stationary track **22** may be positioned at an outside edge of the person conveyor portion **16**, such that stationary tracks **22**, **24** are positioned parallel to and on both sides of the person conveyor portion **16** of the conveyor **14**. As will be described with reference to the process dolly **40**, the stationary tracks **22**, **24** allow for the process dolly **40** to remain stationary relative to motion of the conveyor **14** prior to synchronization with a contact feature of the conveyor **14**.

FIG. **2** illustrates a view of the conveyor assembly **10** from underneath the work part **30**. Illustrated in FIG. **2** are various objects coupled to the conveyor **14** that may be used as a contact feature for synchronizing a movement of the process dolly **40** to a movement of the conveyor **14**. Accordingly, the contact feature of the conveyor **14** may be any object that moves in synchronization with the conveyor **14**. For example, the contact feature may be an object that is coupled either the work part conveyor portion **18** or the person conveyor portion **16**. The contact feature need not be a dedicated feature of the conveyor **14**. Instead, the contact feature may have a dual purpose. For example, the contact feature may be a part pedestal **32** that is configured to support the work part **30** thereon. However, other contact features are also contemplated and possible. For example, a second contact feature, block **34**, is illustrated as coupled to the work part conveyor portion **18** of the conveyor **14** proximate to the stationary track **24**. As will be described in further detail below, the syncing apparatus **100** may be adjusted so as to be able to come in contact with any desired contact feature.

The process dolly **40** in both FIGS. **1** and **2** is illustrated as positioned upstream of the pedestal **32** in the +X direction of the depicted coordinate axes. Referring again to FIG. **1**, the process dolly **40** may include a frame **42** and wheels **44** rotatably coupled to the frame **42**. The frame **42** may be configured to hold tools, parts, and the like for use on work parts **30** (e.g., a vehicle chassis) traveling along the conveyor **14**. The wheels **44** of the process dolly **40** may sit within the stationary tracks **22**, **24** such that the process dolly **40** is isolated from movement of the conveyor **14** until the process dolly **40** is synchronized with a contact feature of the conveyor **14**. When synchronized, the wheels **44** of the process dolly **40** can rotate within the stationary tracks **22**, **24** and traverse the stationary tracks **22**, **24** in synchronization with the movement of the conveyor **14**.

FIGS. **3**A and **3**B illustrate the syncing apparatus **100** for synchronizing the process dolly **40** with a movement of the conveyor **14**. The syncing apparatus **100** includes a mounting frame **104** and a sync arm **110** coupled to the mounting frame **104**. As will be described in greater detail herein, and as illustrated in FIGS. **4**A-**4**D, contact between the sync arm **110** and a contact feature of the conveyor **14** may synchronize the process dolly **40**, which is attached to the syncing apparatus **100**, to a movement of the conveyor **14**.

The mounting frame **104** may be any structure that is capable of mounting the sync arm **110** to the process dolly **40**. For example, referring also to FIG. **2**, illustrating a syncing apparatus **100** mounted to a process dolly **40**, the mounting frame **104** may be a bracket that is mountable onto a frame **42** of the process dolly **40** either directly or through multiple mounting frames. Referring again to FIGS. **3**A and **3**B, the mounting frame **104** may define mounting grooves **106** that extend along a length of the mounting frame **104**. For example, the mounting frame **104** may include one or more mounting surfaces **105** and each mounting surface **105** may include one or more mounting grooves **106** extending along a length of each mounting surface **105** of the mounting frame **104**. The mounting grooves **106** may facilitate mounting of the sync arm **110** to the mounting frame **104** as well as allowing adjustment of the position of the sync arm **110** relative to the mounting frame **104**. The mounting frame **104** may be produced from extruded aluminum.

The mounting frame **104** may be mountable to the frame **42** of the process dolly **40** through fasteners or the like. For example, one or more of the mounting grooves **106** may facilitate coupling of the mounting frame **104** to the process dolly **40**. In some embodiments, and as noted above, multiple mounting frames may be used. Referring again to FIG. **2**, a perspective view of the syncing apparatus **100** coupled to the frame **42** of the process dolly **40** from underneath the work part **30** is illustrated. In the illustrated embodiments, the mounting frame **104** may be a first mounting frame **104** that is adjustably coupled to a second mounting frame **107**. The second mounting frame **107** may have a similar structure to mounting frame **104** and include mounting grooves **160** to facilitate mounting of the first mounting frame **104** to the second mounting frame **107** anywhere along the mounting grooves **160**. In embodiments, the second mounting frame **107** may be directly mounted to the process dolly **40** or, as shown in FIG. **2** the second mounting frame **107** may be mounted to the process dolly **40** through a third mounting frame **108** also having one or more mounting grooves **162** formed therein. Any number of mounting frames may be used to mount the sync arm **110** to the frame **42** of the process dolly **40**. Using various mounting frames may allow a user to customize the position of the sync arm **110** relative to the process dolly **40** such that the process dolly **40** is positioned in a desired position relative to the work part **30** traveling along the conveyor **14**. In some embodiments, a support wheel **103** may be mounted to one of the mounting frames (e.g., the second mounting frame **107** in the illustrated embodiment of FIG. **2**) to provide additional support to the syncing apparatus **100**. The support wheel **103** may sit within the stationary track **24** so as not to move with the conveyor **14** until the sync arm **110** contacts a contact feature of the conveyor **14**.

Referring again to FIGS. **3**A and **3**B, the sync arm **110** is adjustably coupled to the mounting frame **104**. For example, the sync arm **110** is adjustably coupled to the mounting frame **104** through a support bracket **112**. The support bracket **112** may be an L-shaped bracket having a bracket support arm **114** configured to be coupled to the mounting frame **104** and a sync support arm **116** that supports movement of the sync arm **110**. The bracket support arm **114** and the sync support arm **116** may be positioned perpendicularly to one another.

The bracket support arm **114** is configured to interface with a mounting surface **105** of the mounting frame **104**. The bracket support arm **114** may be configured to allow a fastener to pass therethrough and into a mounting groove **106** of the mounting frame **104**. In some embodiments, multiple fasteners can extend from the bracket support arm **114** into multiple mounting grooves **106** of the mounting frame **104**. The position of the support bracket **112** along the mounting grooves **106** of the mounting frame **104** can be adjusted, which adjusts the position of the bracket support arm **114** relative to the mounting frame **104**. The fasteners can then be tightened at a desired location to prevent unwanted movement of the support bracket **112** relative to the mounting frame **104**.

The sync arm **110** generally includes a wheel **120** and a biasing member **130** operatively coupled to the wheel **120** and configured to bias the wheel **120** to an extended position. As will be described in greater detail, the wheel **120** is configured to contact the contact feature of the conveyor **14** to synchronize the process dolly **40** to the movement of the conveyor **14** when the wheel **120** is biased to the extended position. Compression of the biasing member **130** moves the wheel **120** to a retracted position wherein the wheel **120** is configured to traverse the contours of the contact feature and lose contact with the contact feature such that the dolly is unsynchronized from the movement of the conveyor **14**.

The wheel **120** may be a caster wheel that includes a wheel support frame **122**. The wheel support frame **122** may rigidly align the wheel **120** in a rolling direction such that contact with the wheel **120** does not cause the wheel **120** swivel.

To support motion of the wheel **120** from an extended position to a retracted position, the biasing member **130** may include a linear bearing **140**, an alignment rod **134**, and a helical spring **132**. The linear bearing **140** may be fixed relative to the mounting frame **104**. For example, and as illustrated in FIGS. **3**A and **3**B, the linear bearing **140** may be coupled to the sync support arm **116** of the support bracket **112**. As will be described in greater detail, the linear bearing **140** defines a bearing passage through which the alignment rod **134** may translate.

The alignment rod **134** may be coupled to the wheel support frame **122** of the wheel **120** at one end and, as described above, extend through the linear bearing **140** to a free end **136**, wherein the alignment rod **134** is translatable relative to the linear bearing **140**. In particular, the alignment rod **134** extends through the bearing passage of the linear bearing **140**. In some embodiments, the sync support arm **116** may define an aperture therethrough that is aligned with the bearing passage of the linear bearing **140**. Accordingly, the alignment rod **134** may pass through both the bearing passage of the linear bearing **140** and the aperture of the sync support arm **116** and be translatable therethrough. Both FIGS. **3**A and **3**B illustrate the sync arm **110** in an extended position. As illustrated, when in the extended position the free end **136** of alignment rod **134** extends beyond an outer surface **117** of the sync support arm **116**.

In some embodiments, a stopper **150** may be coupled to the free end **136** of the alignment rod **134** at a position beyond the outer surface **117** of the sync support arm **116**. In some embodiments, the stopper **150** may be adjustably mounted on to the free end **136** of the alignment rod **134**. For example, the stopper **150** may be positioned along the alignment rod **134** to adjust the effective length of the alignment rod **134** capable of moving through the linear bearing **140**. In other embodiments, it is contemplated that the stopper **150** may be tightly or otherwise immovably coupled to the free end **136** of the alignment rod **134**. To limit linear motion of the alignment rod **134** through the linear bearing **140**, the stopper **150** may have a dimension greater than a diameter of the aperture of the sync support arm **116**, such that when the sync arm **110** is biased to the extended position, the stopper **150** contacts an outer surface **117** of the sync support arm **116** of the support bracket **112** and prevents further movement of the alignment rod **134** through the sync support arm **116** and the linear bearing **140**.

In some embodiments, to prevent rotation of the wheel **120** about an axis defined by the alignment rod **134**, a rotation stop **123** may be provided. The rotation stop **123** may be any object capable of preventing rotation of the wheel **120** about the alignment rod **134**. In some embodiments, the rotation stop **123** may be a dedicated object coupled to the wheel **120**, the wheel support frame **122**, or the alignment rod **134**, for example. In other embodiments, the wheel support frame **122** may be the rotation stop **123**. For example, in the present embodiment the wheel support frame **122** includes a contact edge **126** positioned proximate to the mounting surface **105** of the mounting frame **104**. In some embodiments, the contact edge **126** may be positioned in contact with the mounting surface **105** of the mounting frame **104**. Accordingly, the interface between the contact edge **126** of the wheel support frame **122** and the mounting surface **105** of the mounting frame **104** may substantially prevent axial rotation of the wheel **120** about the axis defined by the alignment rod **134**.

The helical spring **132** of the biasing member **130** may circumscribe the alignment rod **134** between the wheel support frame **122** and the linear bearing **140** so as to be compressed between the wheel support frame **122** and the linear bearing **140**. The helical spring **132** may accordingly exert a force on the wheel support frame **122** and the linear bearing **140** to bias the wheel **120** to the extended position. The force applied by the spring **132** may be adjusted by moving the stopper **150** closer to or farther from the free end **136** of the alignment rod **134**. For example, moving the stopper **150** farther down the alignment rod **134** would effectively shorten the length of the alignment rod **134** that the spring **132** extends along, which may cause greater compression in the spring **132**. However, moving the stopper **150** farther up the alignment rod **134** toward the free end **136** would effectively lengthen the length of the alignment rod

134 that the spring 132 extends along, which may reduce the compression experienced by the spring 132.

Referring again to FIG. 2, as noted herein, contact between the syncing apparatus 100 and a contact feature of the conveyor 14 causes the process dolly 40 to become synchronized to a movement of the conveyor 14. The conveyor 14 may have multiple contact features coupled to thereto. In embodiments, the sync arm 110 of the syncing apparatus 100 is coupled to the mounting frame 104 so as to contact a desired contact feature. For example, as noted above, the contact feature of the conveyor 14 may be the part pedestal 32 coupled to the work part conveyor portion 18 of the conveyor 14. In such embodiments, the wheel 120 of the syncing apparatus 100 is directed upward so as to be able to contact the part pedestal 32. However, when, for example, block 34 is utilized as the contact feature, the wheel 120 of the syncing apparatus 100 may be directed downward so as to be able to contact the block 34.

FIGS. 4A-4D illustrates the synchronization of the process dolly 40 to the contact feature (e.g., part pedestal 32) of the conveyor 14 with the syncing apparatus 100. In FIG. 4A the process dolly 40 is positioned upstream of the movement of the conveyor 14, indicated by arrow 50. In FIG. 4B the contact feature of the conveyor 14 has contacted the wheel 120 of the contact feature. This contact between the wheel 120 and the part pedestal 32 causes the process dolly 40 to move along the stationary track 22 in synchronization with the movement of the conveyor 14. Accordingly the process dolly 40 and the conveyor 14 are moving in the direction of arrow 50. When the process dolly 40 is no longer needed, a force F can be applied to the process dolly 40 or the syncing apparatus 100 in a direction opposite of to the movement of the conveyor 14 (arrow 50). The wheel 120 is positioned at a height relative to the contact feature such that the application of the force F and friction between the wheel 120 and the contact feature causes the wheel 120 to rotate and compress under the part pedestal 32. Referring to FIG. 4C, the wheel 120 is illustrated as compressed under the part pedestal 32. Specifically, as the wheel 120 is pushed under the part pedestal 32, the wheel 120 is pushed downward, which causes the alignment rod 134 to move through the linear bearing 140, and the helical spring 132 to be compressed between the wheel support frame 122 and the linear bearing 140. As illustrated the stopper 150 is now spaced from the sync support arm 116 of the support bracket 112. In this retracted configuration, the wheel 120 is able to traverse the contours of the contact feature of the conveyor 14. Referring to FIG. 4D, once the contact feature has moved past the wheel 120 of the syncing apparatus 100, the wheel 120 is able to move back to the extended position due to the biasing force provided by the biasing member 130 of the syncing apparatus 100. The process dolly 40 is, thus, unsynchronized from the movement of the conveyor 14. The process dolly 40 may then be synchronized to a subsequent contact feature of the conveyor 14.

It should now be understood that embodiments described herein are directed to a syncing apparatus for synchronizing a process dolly to a movement of the conveyor. In particular, syncing apparatuses according to the present disclosure generally include a wheel and a biasing member coupled to the wheel and configured to bias the wheel to an extended position. When biased to the extended position, the wheel may contact a contact feature of the conveyor such that the process dolly, to which the syncing apparatus is attached, moves with the contact feature of the conveyor. When synchronization is no longer needed, force can be applied to the process dolly in a direction opposite the direction of movement of the conveyor. The contact feature may be positioned at such a height relative to the wheel that the force causes the wheel to roll over the contours of the contact feature while the biasing element allows the wheel of move to a retracted state such that the wheel remains in contact with the contact feature until it traverses completely past the contact feature. Accordingly, due to the rolling of the wheel over the contact feature, the syncing apparatus experiences much less wear than previous methods that used resilient urethane scrapers to contact a conveyor contact feature.

It is noted that the terms “substantially” and “about” may be utilized herein to represent the inherent degree of uncertainty that may be attributed to any quantitative comparison, value, measurement, or other representation. These terms are also utilized herein to represent the degree by which a quantitative representation may vary from a stated reference without resulting in a change in the basic function of the subject matter at issue.

While particular embodiments have been illustrated and described herein, it should be understood that various other changes and modifications may be made without departing from the spirit and scope of the claimed subject matter. Moreover, although various aspects of the claimed subject matter have been described herein, such aspects need not be utilized in combination. It is therefore intended that the appended claims cover all such changes and modifications that are within the scope of the claimed subject matter.

What is claimed is:

1. A syncing apparatus for synchronizing a process dolly to a conveyor, the syncing apparatus comprising:
- a mounting frame configured to be mounted to a frame of the process dolly; and
- a sync arm coupled to the mounting frame, the sync arm comprising:
  - a wheel; and
  - a spring coupled to the wheel and configured to bias the wheel to an extended position, wherein:
    - the wheel is configured to contact a contact feature of the conveyor to synchronize the process dolly to a movement of the conveyor when biased to the extended position; and
    - compression of the spring moves the wheel to a retracted position wherein the wheel is configured to traverse the contact feature of the conveyor and the process dolly is unsynchronized from the movement of the conveyor.

2. The syncing apparatus of claim 1, wherein the sync arm is adjustably coupled to the mounting frame.

3. The syncing apparatus of claim 1, further comprising a support bracket coupling the sync arm to the mounting frame, wherein the support bracket is adjustably coupled to the mounting frame.

4. The syncing apparatus of claim 1, wherein the spring is a helical spring.

5. The syncing apparatus of claim 1, wherein
- the wheel comprises a wheel support frame; and
- the sync arm further comprises:
  - a linear bearing configured to be fixed relative to the mounting frame; and
  - an alignment rod coupled to the wheel support frame and extending through the linear bearing, wherein the alignment rod is translatable relative to the linear bearing, wherein the spring is a helical spring circumscribing the alignment rod between the wheel support frame and the linear bearing to bias the wheel to the extended position.

6. The syncing apparatus of claim 5, further comprising a support bracket coupling the sync arm to the mounting frame, wherein the support bracket comprises:

a bracket support arm configured to be coupled to the mounting frame; and

a sync support arm comprising an aperture formed therein, wherein the alignment rod passes through the aperture and is translatable relative to the aperture.

7. The syncing apparatus of claim 6, further comprising a stopper coupled to a free end of the alignment rod and having a dimension greater than a diameter of the aperture, wherein the stopper limits a linear motion of the alignment rod through the aperture.

8. The syncing apparatus of claim 6, further comprising a rotation stop configured to prevent axial rotation of the wheel about an axis defined by the alignment rod.

9. A process dolly, comprising:

a frame, and

a syncing apparatus coupled to the frame and configured to synchronize the process dolly to a movement of a conveyor, wherein the syncing apparatus comprises a sync arm comprising:

a wheel; and

a spring coupled to the wheel, the spring biasing the wheel to an extended position, wherein:

the wheel is configured to contact a contact feature of the conveyor to synchronize the process dolly to the movement of the conveyor; and

compression of the spring moves the wheel to a retracted position wherein the wheel traverses the contact feature of the conveyor and the process dolly is unsynchronized from the movement of the conveyor.

10. The process dolly of claim 9, wherein the syncing apparatus is adjustably coupled to the frame.

11. The process dolly of claim 9, further comprising a mounting frame mounted to the frame and coupling the syncing apparatus to the frame.

12. The process dolly of claim 11, wherein:

the wheel of the syncing apparatus comprises a wheel support frame; and

the sync arm of the syncing apparatus further comprises:

a linear bearing configured to be fixed relative to the mounting frame;

an alignment rod coupled to the wheel support frame and extending through the linear bearing, wherein the alignment rod is translatable relative to the linear bearing, wherein the spring is a helical spring circumscribing the alignment rod between the wheel support frame and the linear bearing to bias the wheel to the extended position.

13. The process dolly of claim 12, wherein the syncing apparatus further comprises a support bracket coupling the sync arm to the mounting frame, wherein the support bracket comprises:

a bracket support arm configured to be coupled to the mounting frame; and

a sync support arm comprising an aperture formed therein, wherein the alignment rod passes through the aperture and is translatable relative to the aperture.

14. The process dolly of claim 13, wherein the syncing apparatus further comprises a stopper coupled to a free end of the alignment rod and having a dimension greater than a diameter of the aperture, wherein the stopper limits a linear motion of the alignment rod through the aperture.

15. The process dolly of claim 12, wherein the syncing apparatus further comprises a rotation stop configured to prevent rotation of the about an axis defined by the alignment rod.

16. A conveyor assembly comprising:

a conveyor having a contact feature; and

a process dolly configured to be synchronized to a movement of the conveyor, the process dolly comprising:

a frame, and

a syncing apparatus coupled to the frame and configured to synchronize the process dolly to the movement of the conveyor, the syncing apparatus comprises a sync arm comprising:

a wheel; and

a spring coupled to the wheel, the spring biasing the wheel to an extended position, wherein:

the wheel is configured to contact the contact feature of the conveyor to synchronize the process dolly to the movement of the conveyor; and

compression of the biasing member spring moves the wheel to a retracted position wherein the wheel traverses the contact feature of the conveyor and the process dolly is unsynchronized from the movement of the conveyor.

17. The conveyor assembly of claim 16, further comprising a mounting frame mounted to the frame of the process dolly and coupling the syncing apparatus to the frame of the process dolly wherein:

the wheel of the syncing apparatus comprises a wheel support frame; and

the sync arm of the syncing apparatus comprises:

a linear bearing configured to be fixed relative to the mounting frame;

an alignment rod coupled to the wheel support frame and extending through the linear bearing, wherein the alignment rod is translatable relative to the linear bearing, and wherein the spring is a helical spring circumscribing the alignment rod between the wheel support frame and the linear bearing to bias the wheel to the extended position.

18. The conveyor assembly of claim 17, wherein the syncing apparatus further comprises a support bracket coupling the sync arm to the mounting frame, wherein the support bracket comprises:

a bracket support arm configured to be coupled to the mounting frame; and

a sync support arm comprising an aperture formed therein, wherein the alignment rod passes through the aperture and is translatable relative to the aperture.

19. The conveyor assembly of claim 18, wherein the syncing apparatus further comprises a stopper coupled to a free end of the alignment rod and having a dimension greater than a diameter of the aperture, wherein the stopper limits a linear motion of the alignment rod through the aperture.

20. The conveyor assembly of claim 17, wherein the syncing apparatus further comprises a rotation stop configured to prevent rotation of the about an axis defined by the alignment rod.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 10,894,313 B2
APPLICATION NO. : 15/988486
DATED : January 19, 2021
INVENTOR(S) : Michael P. Meyer

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

In Column 10, Line(s) 23, Claim 16, delete "**biasing member**".

Signed and Sealed this
Ninth Day of March, 2021

Drew Hirshfeld
Performing the Functions and Duties of the
Under Secretary of Commerce for Intellectual Property and
Director of the United States Patent and Trademark Office